between $27,680 and $45,750. The lowest 10 percent earned less than $21,710 and the highest 10 percent earned more than $62,540. Median annual earnings in the industries employing the largest numbers of engineering technicians in 1997 are shown below:

Engineering and architectural services	$36,600
Computer and data processing services	33,600
Computer and office equipment	33,000
Electrical components and accessories	32,100
Personnel supply services	25,400

Median annual earnings of all other engineering technicians and technologists in 1998 were $37,310. The middle 50 percent earned between $28,510 and $47,610. The lowest 10 percent earned less than $22,230 and the highest 10 percent earned more than $68,720. Median annual earnings in the industries employing the largest numbers of other engineering technicians and technologists in 1997 are shown below:

Federal Government	$42,700
Electrical components and accessories	33,500
Engineering and architectural services	32,600
Local government	32,200
State government	27,500

In the Federal Government, engineering technicians started at about $18,600, $21,200, or $25,000 in early 1999, depending on their education and experience. Beginning salaries were slightly higher in selected areas of the country where the prevailing local pay level was higher.

Related Occupations

Engineering technicians apply scientific and engineering principles usually acquired in postsecondary programs below the baccalaureate level. Similar occupations include science technicians, drafters, surveyors, broadcast and sound technicians, and health technologists and technicians.

Sources of Additional Information

For a small fee, information on a variety of engineering technician and technology careers is available from:

☛ The Junior Engineering Technical Society (JETS), at 1420 King St., Suite 405, Alexandria, VA 22314-2794. Enclose $3.50 to obtain a full package of guidance materials and information. Brochures are available free on JETS Internet site: **http://www.jets.org**

Information on ABET-accredited engineering technology programs is available from:

☛ Accreditation Board for Engineering and Technology, Inc. 111 Market Place, Suite 1050, Baltimore, MD 21202. Internet: **http://www.abet. org**

Architects, Surveyors, and Drafters

Architects, Except Landscape and Naval

(O*NET 22302)

Significant Points

- About 30 percent were self-employed—over three times the proportion for all professionals.
- Licensing requirements include a professional degree in architecture, a period of practical training or internship, and passing all divisions of the Architect Registration Examination.
- Beginners may face competition, especially for jobs in the most prestigious firms; summer internship experience and knowledge of computer-aided design and drafting technology are advantages.

Nature of the Work

Architects design buildings and other structures. The design of a building involves far more than its appearance. Buildings must also be functional, safe, and economical, and must suit the needs of the people who use them. Architects take all these things into consideration when they design buildings and other structures.

Architects provide professional services to individuals and organizations planning a construction project. They may be involved in all phases of development, from the initial discussion with the client through the entire construction process. Their duties require specific skills—designing, engineering, managing, supervising, and communicating with clients and builders.

The architect and client discuss the objectives, requirements, and budget of a project. In some cases, architects provide various predesign services—conducting feasibility and environmental impact studies, selecting a site, or specifying the requirements the design must meet. For example, they may determine space requirements by researching the number and type of potential users of a building. The architect then prepares drawings and a report presenting ideas for the client to review.

After the initial proposals are discussed and accepted, architects develop final construction plans. These plans show the building's appearance and details for its construction. Accompanying these are drawings of the structural system; air-conditioning, heating, and ventilating systems; electrical systems; plumbing; and possibly site and landscape plans. They also specify the building materials and, in some cases, the interior furnishings. In developing designs, architects follow building codes, zoning laws, fire regulations, and other ordinances, such as those requiring easy access by disabled persons. Throughout the planning stage, they make necessary changes. Although they have traditionally used pencil and paper to produce design and construction drawings, architects are increasingly turning to computer-aided design and drafting (CADD) technology for these important tasks.

Architects may also assist the client in obtaining construction bids, selecting a contractor, and negotiating the construction contract. As construction proceeds, they may visit the building site to ensure the contractor is following the design, adhering to the schedule, using the specified materials, and meeting quality work standards. The job is not complete until all construction is finished, required tests are made, and construction costs are paid. Sometimes, architects also provide postconstruction services, such as facilities management. They advise on energy efficiency measures, evaluate how well the building design adapts to the needs of occupants, and make necessary improvements.

Architects design a wide variety of buildings, such as office and apartment buildings, schools, churches, factories, hospitals, houses, and airport terminals. They also design complexes such as urban centers, college campuses, industrial parks, and entire communities. They may also advise on the selection of building sites, prepare cost analysis and land-use studies, and do long-range planning for land development.

Architects sometimes specialize in one phase of work. Some specialize in the design of one type of building—for example, hospitals, schools, or housing. Others focus on planning and predesign

Architects spend much of their time updating plans after receiving feedback from other design professionals.

services or construction management, and do little design work. They often work with engineers, urban planners, interior designers, landscape architects, and others. In fact, architects spend a great deal of their time in coordinating information from, and the work of, other professionals engaged in the same project. Consequently, architects are now using the Internet to update designs and communicate changes for the sake of speed and cost savings.

During a training period leading up to licensing as architects, entry-level workers are called intern-architects. This training period, which generally lasts three years, gives them practical work experience while they prepare for the Architect Registration Examination (ARE). Typical duties may include preparing construction drawings on CADD, or assisting in the design of one part of a project.

Working Conditions

Architects usually work in a comfortable environment. Most of their time is spent in offices consulting with clients, developing reports and drawings, and working with other architects and engineers. However, they often visit construction sites to review the progress of projects.

Architects may occasionally be under stress, working nights and weekends to meet deadlines. In 1998, almost 2 out of 5 architects worked more than 40 hours a week, in contrast to 1 in 4 workers in all occupations combined.

Employment

Architects held about 99,000 jobs in 1998. The majority of jobs were in architectural firms—most of which employ fewer than 5 workers. A few worked for general building contractors, and for government agencies responsible for housing, planning, or community development, such as the U.S. Departments of Defense and Interior, and the General Services Administration. About 3 in 10 architects were self-employed.

Training, Other Qualifications, and Advancement

All States and the District of Columbia require individuals to be licensed (registered) before they may call themselves architects or contract to provide architectural services. Many architecture school graduates work in the field even though they are not licensed. However, a licensed architect is required to take legal responsibility for all work. Licensing requirements include a professional degree in architecture, a period of practical training or internship, and passage of all sections of the ARE.

In many States, the professional degree in architecture must be from one of the 105 schools of architecture with programs accredited by the National Architectural Accrediting Board (NAAB). However, State architectural registration boards set their own standards, so graduation from a non NAAB-accredited program may meet the educational requirement for licensing in some States. Several types of professional degrees in architecture are available through colleges and universities. The majority of all architectural degrees are from 5-year Bachelor of Architecture programs, intended for students entering from high school or with no previous architectural training. Some schools offer a 2-year Master of Architecture program for students with a preprofessional undergraduate degree in architecture or a related area, or a 3- or 4-year Master of Architecture program for students with a degree in another discipline. In addition, there are many combinations and variations of these programs.

The choice of degree type depends upon each individual's preference and educational background. Prospective architecture students should consider the available options before committing to a program. For example, although the 5-year Bachelor of Architecture program offers the fastest route to the professional degree, courses are specialized and, if the student does not complete the program, moving to a nonarchitectural program may be difficult. A typical program includes courses in architectural history and theory, building design, professional practice, math, physical sciences, and liberal arts. Central to most architectural programs is the design studio, where students put into practice the skills and concepts learned in the classroom. During the final semester of many programs, students devote their studio time to creating an architectural project from beginning to end, culminating in a 3-dimensional model of their design.

Many schools of architecture also offer graduate education for those who already have a bachelor's or master's degree in architecture or other areas. Although graduate education beyond the professional degree is not required for practicing architects, it is for research, teaching, and certain specialties.

Architects must be able to visually communicate their ideas to clients. Artistic and drawing ability is very helpful in doing this, but not essential. More important are a visual orientation and the ability to conceptualize and understand spatial relationships. Good communication skills, the ability to work independently or as part of a team, and creativity are important qualities for anyone interested in becoming an architect. Computer literacy is also required as most firms use computers for writing specifications, 2- and 3-dimensional drafting, and financial management. A knowledge of computer-aided design and drafting (CADD) is helpful and will become essential as architectural firms continue to adopt this technology. Recently, the profession recognized National CAD Standards (NCS); architecture students who master NCS will have an advantage in the job market.

All State architectural registration boards require a training period before candidates may sit for the ARE and become licensed. Many States have adopted the training standards established by the Intern Development Program, a branch of the American Institute of Architects and the National Council of Architectural Registration Boards. These standards stipulate broad and diversified training under the supervision of a licensed architect over a 3-year period. New graduates usually begin as intern-architects in architectural firms, where they assist in preparing architectural documents or drawings. They may also do research on building codes and materials, or write specifications for building materials, installation criteria, the quality of finishes, and other related details. Graduates with degrees in architecture also enter related fields such as graphic, interior, or industrial design; urban planning; real estate development; civil engineering; or construction management. In such cases, an architectural license (and thus the internship period) is not required.

After completing the internship period, intern-architects are eligible to sit for the ARE. The examination tests candidates on architectural knowledge, and is given in sections throughout the year. Candidates who pass the ARE and meet all standards established by their State board are licensed to practice in that State.

After becoming licensed and gaining experience, architects take on increasingly responsible duties, eventually managing entire projects. In large firms, architects may advance to supervisory or managerial positions. Some architects become partners in established firms; others set up their own practice.

Several States require continuing education to maintain a license, and many more States are expected to adopt mandatory continuing education. Requirements vary by State, but usually involve the completion of a certain number of credits every year or two through seminars, workshops, formal university classes, conferences, self-study courses, or other sources.

Job Outlook

Prospective architects may face competition for entry-level jobs, especially if the number of architectural degrees awarded remain at current levels or increases. Employment of architects is projected to grow about as fast as the average for all occupations through 2008 and additional job openings will stem from the need to replace architects who retire or leave the labor force for other reasons. However, many individuals are attracted to this occupation, and the number of applicants often exceeds the number of available jobs, especially in the most prestigious firms. Prospective architects who complete at least one summer internship—either paid or unpaid—while in school and who know CADD technology (especially that which conforms to the new national standards) will have a distinct advantage in obtaining an intern-architect position after graduation.

Employment of architects is strongly tied to the level of local construction, particularly nonresidential structures such as office buildings, shopping centers, schools, and healthcare facilities. After a boom in non-residential construction during the 1980s, building slowed significantly during the first half of the 1990s. Despite slower labor force growth and increases in telecommuting and flexiplace work, however, non-residential construction is expected to grow more quickly between 1998 and 2008 than during the previous decade, driving demand for more architects.

As the stock of buildings ages, demand for remodeling and repair work should grow considerably. The needed renovation and rehabilitation of old buildings, particularly in urban areas where space for new buildings is becoming limited, is expected to provide many job opportunities for architects. In addition, demographic trends and changes in health care delivery are influencing the demand for certain institutional structures, and should also provide more jobs for architects in the future. For example, increases in the school-age population have resulted in new school construction. Additions to existing schools (especially colleges and universities), as well as overall modernization, will continue to add to demand for architects through 2008. Growth is expected in the number of adult care centers, assisted-living facilities, and community health clinics, all of which are preferable, less costly alternatives to hospitals and nursing homes.

Because construction—particularly office and retail—is sensitive to cyclical changes in the economy, architects will face particularly strong competition for jobs or clients during recessions, and layoffs may occur. Those involved in the design of institutional buildings such as schools, hospitals, nursing homes, and correctional facilities, will be less affected by fluctuations in the economy.

Even in times of overall good job opportunities, however, there may be areas of the country with poor opportunities. Architects who are licensed to practice in one State must meet the licensing requirements of other States before practicing elsewhere. These requirements are becoming more standardized, however, facilitating movement to other States.

Earnings

Median annual earnings of architects were $47,710 in 1998. The middle 50 percent earned between $37,380 and $68,920. The lowest 10 percent earned less than $30,030 and the highest 10 percent earned more than $87,460.

According to the American Institute of Architects, the median compensation, including bonuses, for intern-architects in architectural firms was $35,200 in 1999. Licensed architects with 3 to 5 of years experience had median earnings of $41,100; licensed architects with 8 to 10 years of experience, but who were not managers or principals of a firm, earned $54,700. Principals or partners of firms had median earnings of $132,500 in 1999, although partners in some large practices earned considerably more. Similar to other industries, small architectural firms (fewer than 5 employees) are less likely than larger firms to provide employee benefits.

Earnings of partners in established architectural firms may fluctuate because of changing business conditions. Some architects may have difficulty establishing their own practices, and may go through a period when their expenses are greater than their income, requiring substantial financial resources.

Related Occupations

Architects design and construct buildings and related structures. Others who engage in similar work are landscape architects, building contractors, civil engineers, urban planners, interior designers, industrial designers, and graphic designers.

Sources of Additional Information

Information about education and careers in architecture can be obtained from:

☛ Careers in Architecture Program, The American Institute of Architects, 1735 New York Ave. NW., Washington, DC 20006.
Internet: **http://www.aiaonline.com**

Drafters

(O*NET 22514A, 22514B, 22514C, 22514D, and 22517)

Significant Points

- The type and quality of postsecondary drafting programs varies considerably; prospective students should be careful in selecting a program.
- Opportunities should be best for individuals who have at least 2 years of postsecondary training in drafting and considerable skill and experience using computer-aided drafting (CAD) systems.
- Demand for particular drafting specializations varies geographically, depending on the needs of local industry.

Nature of the Work

Drafters prepare technical drawings and plans used by production and construction workers to build everything from manufactured products such as spacecraft or industrial machinery to structures such as office buildings or oil and gas pipelines. Their drawings provide visual guidelines, showing the technical details of the products and structures, specifying dimensions, materials to be used, and procedures and processes to be followed. Drafters fill in technical details, using drawings, rough sketches, specifications, codes, and calculations previously made by engineers, surveyors, architects, or scientists. For example, they use their knowledge of standardized building techniques to draw in the details of a structure. Some drafters use their knowledge of engineering and manufacturing theory and standards to draw the parts of a machine in order to determine design elements such as the number and kind of fasteners needed to assemble it. They use technical handbooks, tables, calculators, and computers to do this.